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PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)	
	:	Examiner: Not Yet Assigned
CAMERON BOLITHO BROWNE, ET AL.	)	
	:	Group Art Unit: 2772
Application No.: 09/449,969	)	
	:	
Filed: November 26, 1999	)	
	:	
For: AUTOMATIC KERNING OF TEXT	)	Date: January 20, 2000

Assistant Commissioner for Patents
Washington, D.C. 20231

CLAIM TO PRIORITY

Sir:

Applicants hereby claim priority under the International Convention and all rights to which they are entitled under 35 U.S.C. § 119 based upon the following Australian Provisional Priority Applications:

PP7404, filed November 27, 1998; and

PP7718, filed December 15, 1998.

Certified copies of the priority documents are enclosed.

Applicants' undersigned attorney may be reached in our New York office by telephone at (212) 218-2100. All correspondence should continue to be directed to our address given below.

Respectfully submitted,

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09/449 969
GAU: 2772
#4

AUSTRALIA

Patent Office
Canberra

I, KIM MARSHALL, MANAGER PATENT OPERATIONS hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PP 7404 for a patent by CANON KABUSHIKI KAISHA filed on 27 November 1998.

WITNESS my hand this
Second day of December 1999

KIM MARSHALL
MANAGER PATENT OPERATIONS

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S & F Ref: 425421

ORIGINAL

AUSTRALIA

Patents Act 1990

PROVISIONAL SPECIFICATION FOR THE INVENTION ENTITLED:

A Method and Apparatus for Kerning Text

Name and Address
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Names of Inventors: Cameron Bolitho Browne, Michael Richard Arnold and Paul Quentin Scott

This invention is best described in the following statement:

A Method and Apparatus for Kerning Text

The present invention relates to kerning and, in particular, a method of adjusting the kerning distance between adjacent characters without use of previously stored kerning distances for character pairs.

Background Art

The traditional way of automatically providing kerning is to have a look-up table for each possible pair of characters in a font giving the kerning distance for that pair of characters. In this way the printer or other display device knows to what extent the spacing between the characters should be adjusted in order to give an aesthetically pleasing result. The kerning distances entered in such memories or look-up tables are essentially empirically derived.

This process is difficult if the number of characters is very large since the number of entries in the look-up table then very substantially expands. One approach to this problem is described in US Patent No. 5,432,890 (Canon KK) in which essentially unidirectional data is used to modify the kerning distance.

The above described arrangement works well with regular character fonts, however, as will be explained hereafter, problems can arise with fonts which are modified or are in some way irregular.

Since the use of modified or otherwise irregular fonts is increasing, the present invention seeks to find a way of automatically adjusting the kerning distance between adjacent characters in order to provide a kerning method which, whilst able to be used with regular characters, is also able to be used with modified or otherwise irregular characters.

Summary of the Invention

In accordance with the first aspect of the present invention there is disclosed a method of adjusting the kerning distance between adjacent characters in a character

string without use of a previously stored distance for each character pair, said adjacent characters comprising a first, positioned character, and a second character to be positioned adjacent said first character and spaced therefrom by the kerning distance, said method comprising the steps of making said second character approach said first character, calculating a two dimensional measure of the approach of said second character to said first character, and stopping said approach when said two dimensional measure passes a threshold value.

Brief Description of the Drawings

Various embodiments of the present invention will now be described with reference to the drawings in which:

Fig. 1 is a schematic representation of known kerning arrangements;

Fig. 2 illustrates how these arrangements break down in the case of modified characters,

Fig. 3 illustrates the need for different kerning spacings based upon the nature of the adjacent characters,

Figs. 4 and 5 illustrate the kerning of adjacent characters in accordance with a first embodiment of the present invention,

Fig. 6 illustrates a histogram of the spacing between adjacent characters in Figs. 4 and 5,

Figs. 7 and 8 illustrate the sequence of events in the kerning of adjacent characters in accordance with a second embodiment of the present invention,

Fig. 9 is a three-dimensional perspective view illustrating the principles of the second embodiment,

Fig. 10 illustrates the "city block" distances from a given pixel P,

Fig. 11 illustrates the "city block" contoured distances from an irregular surface of a character,

Fig. 12 illustrates the use of a convex hull as a limit in kerning,

Fig. 13 illustrates the use of vertical edges of bounding boxes as a limit in kerning, and

Fig. 14 illustrates what might happen to the characters of Fig. 13 in the absence of such a limit.

Detailed Description

Fig. 1 illustrates a prior art kerning technique used with regular characters in which the height of adjacent characters is exactly the (same since the vertical extent of a capital T is the same as the vertical extent of a lower case h). As a consequence, measuring the smallest horizontal distance between adjacent characters can be used to provide an appropriate kerning distance x. A similar measure can be used in the case of, say, a capital T and a lower case o since the lower case o nestles up against the stem of the T by a distance x and it does not matter if the cross-bar of the T extends over the lower case o.

However, if the characters should be modified as indicated in Fig. 2, various difficulties arise. Consider the situation where the modification to the conventional characters is to angle all the cross portions upwardly from left to right so that a capital T has a sloping cross-bar as illustrated in Fig. 2. Under these circumstances, the top of the lower case h is not aligned with the right-hand edge of the cross-bar of the T. As a consequence, using the same horizontal distance x between the adjacent characters results in the two characters being placed too closely together and an aesthetically unpleasing result occurs.

Fig. 3 illustrates the situation where adjacent characters need to be spaced apart to different extents because of the nature of the characters. Where the adjacent pair is Ex, the two characters approach to the closest extent immediately adjacent the "line" upon which the character string is being assembled. Since the characters only approach at this point, the distance between the characters should be relatively small. However, in the event of the character pair Bx, since the lower curve of the B to some extent nestles into the "v" of the side of the lower case x, then the spacing between the

adjacent characters should be increased to provide for the illusion of more "white" space between the "black" characters. Where a look-up table is provided for all the various possible pairs of characters, these aesthetic considerations can be easily taken into account, even if this is essentially empirical or subjective.

However, where characters are able to be modified at will by the user of a computer system, the concept of a look-up table specifying kerning distance becomes unworkable because the number of character pairs is astronomically high. Further, it is generally not possible for the supplier of the computer system to predict all possible combinations of modified characters and empirically determine a kerning spacing for each of them.

Figs. 4 and 5 illustrate how these problems can be overcome by introducing a two-dimensional nature into the measurement of spacing between adjacent characters. In Fig. 4 the characters lower case l and lower case h are to be positioned next to each other in a character string. The position of the "left-hand" character lower case l is first determined and then fixed. The "right-hand" character lower case h is then notionally placed in a start position as illustrated by broken lines and moved to the left as seen in Fig. 4 into a finish position as illustrated by solid lines. As the lower case h approaches the lower case lower case l a series of measurements are taken each of which is a horizontal distance between the right-hand edge of the lower case l and the left-hand edge of the lower case h. The various horizontal distances are spaced apart vertically and result in a histogram as illustrated on the left-hand side of Fig. 6.

As indicated in Fig. 5, a similar process is carried out in relation to adjacent letters lower case l and lower case x. This results in a different series of measurements which are indicated in the right-hand histogram of Fig. 6.

In accordance with the first embodiment of the present invention, the average distance of each histogram is calculated and, in addition, also calculated is the variance of each of the measurements from that average distance. For the left-hand histogram of Fig. 6 it will be apparent that the variance of the histogram is zero. In accordance with the first embodiment of the present invention a zero variance should be equated to a

minimum kerning distance and therefore the lower case h ceases its approach towards the lower case l only when a minimum threshold value is reached. The minimum threshold value is the minimum kerning distance.

However, in relation to the character pair illustrated in Fig. 5, and the resulting right-hand histogram of Fig. 6, it will be seen that there is a substantial variance in the right-hand histogram of Fig. 6. Therefore the approach of the lower case x towards the lower case l in Fig. 5 should be stopped later. That is to say the threshold value is decreased because there is vertical variance from the mean of the various horizontal distances.

Preferably the adjustment of the kerning distance is inversely proportional to the variance.

In the second embodiment illustrated in Figs. 7 and 8, the character pair capital B and lower case c are shown. The left-hand character, B, has a fixed position and the right-hand character, c, is made to approach it from the right. For both characters a contour of spacing from the exterior surface of the character, or the character outline, is calculated by the computer controlling the printer or other display device. As indicated in Figs. 7 and 8, a first contour line being a first predetermined spacing distance from the exterior of the characters is indicated by dotted lines. The outline of the characters themselves is indicated in solid lines. A second contour, being twice the predetermined contour distance from the character outline is indicated by a dot dash line, and so on if necessary. In the embodiment of Figs. 7 and 8, the right-hand character, c, approaches the left-hand character, B, until the second contour lines just intersect as indicated in Fig. 8. This is because for the second embodiment illustrated in Figs. 7 and 8 the threshold value is deemed to be the intersection of the second contour line.

Fig. 9 illustrates schematically in three-dimensional form the placement of the letters E, x, c into a character string. The position of the first character, E, is fixed. The second character, x, is approaching from the right and this approach is stopped when a given contour of the two characters intersect. In Fig. 9 the third character, c, is

"waiting in the wings". Therefore the contours for the character c will not be calculated until such time as the positioning of the second character, x, is finalised. In this way only two full character contours need to be calculated and therefore the computational burden on the computer is reduced. Once the position of the second character, x, is finalised, the contour of the first character, E, is overwritten with the contours already calculated for the character, x, and the contours for the next character, c, are then calculated. These two pairs of contours are then used in order to determine the positioning of that character.

It will be appreciated by those skilled in the art that the spacing between adjacent characters is calculated from the nature of the characters themselves and therefore does not depend upon any previously stored information. In particular there is no kerning look-up table. Naturally there are penalties to be paid in relation to this procedure, particularly in relation to the speed with which the kerning distance between adjacent characters can be determined.

Fig. 10 illustrates one known method of determining a spacing from a given pixel P. The immediately adjacent pixels, of which there are four are numbered 1 and are regarded as being a unit spacing from the pixel P. The next most adjacent pixels, of which there are eight, are regarded as being spaced a distance two units from the pixel P and thus are indicated in Fig. 10 by the numeral 2. This determination of spacing from a given pixel is known as "city block" (or Manhattan distance) spacing.

Fig. 11 illustrates how "city block" spacing can be utilised to determine a spacing contour. In Fig. 11 the shaded pixels constitute, for example, the left-hand side of the character A. As a consequence, the "contour line" being one unit spacing from the character edge is indicated by the line of pixels numbered 1. Similarly, the contour line spaced two units from the edge of the character is indicated by the line of pixels numbered 2, and so on. In this way it is easy to determine a contour map of the general type indicated in Figs. 7, 8 and 9. Other methods of calculating a contour can also be used including Euclidean distance methods.

In some instances it is necessary to provide a limit to the kerning distance to be calculated above. Fig. 12 illustrates one form of limit in which the convex hull of the character as indicated by a broken line in Fig. 12 is used to provide a limit beyond which an adjacent character cannot extend. The convex hull is well known in computing circles to be the outline formed by stretching a rubber band around the character. Fig. 12 illustrates how a lower case o cannot approach an upper case T any closer than the boundary provided by the convex hull of the upper case T.

Figs. 13 and 14 illustrate a similar problem in relation to some other characters being an "on the line dash" (generally used in underlining), a plus sign, and an apostrophe. Fig. 13 illustrates the preferred arrangement in which each character is provided with a rectangular bounding box and the vertical edges of the bounding boxes provide a limit to the closest approach of the characters. Fig. 14 illustrates the possibility which could arise if the limit indicated in Fig. 13 did not apply.

The forgoing describes only some embodiments of the present invention and modifications, obvious to those skilled in the art, can be made thereto without departing from the scope of the present invention.

Aspects of the Invention

The following paragraphs define various aspects of the present invention.

1. A method of adjusting the kerning distance between adjacent characters in a character string without use of a previously stored distance for each character pair, said adjacent characters comprising a first, positioned character, and a second character to be positioned adjacent said first character and spaced therefrom by the kerning distance, said method comprising the steps of making said second character approach said first character, calculating a two dimensional measure of the approach of said second character to said first character, and stopping said approach when said two dimensional measure passes a threshold value.

2. The method as described in paragraph 1 wherein said two-dimensional measure comprises a plurality of one-dimensional measures taken in a first direction and each spaced apart in a second direction, and said method comprising the further steps of:

calculating the mean of said one-dimensional measures,

calculating the variance of said one-dimensional measures from said mean, and

adjusting said threshold value in accordance with said variance.

3. The method as described in paragraph 2 wherein said threshold value is increased in proportion to said variance.

4. The method as described in paragraph 1 wherein said two-dimensional measure comprises a plurality of contours each regularly spaced from the boundary of said characters by a corresponding multiple of a predetermined contour spacing, and said method comprising the further steps of:

stopping said approach when a predetermined one of the contours of both characters intersect.

5. The method as described in paragraph 4 wherein the method of calculating said contours are selected from the group of distance measuring methods

consisting of Euclidean distance, city block distance, and Manhattan distance measuring.

6. The method as described in paragraphs 1-5 wherein a limit is placed on said approach.

7. The method as described in paragraph 6 wherein said limit is no overlap of the vertical sides of upright bounding boxes.

8. The method as described in paragraph 6 wherein said limit is no overlap of bounding boxes comprising convex hulls of said characters.

Dated 27 November, 1998
Canon Kabushiki Kaisha
Patent Attorneys for the Applicant/Nominated Person
SPRUSON & FERGUSON

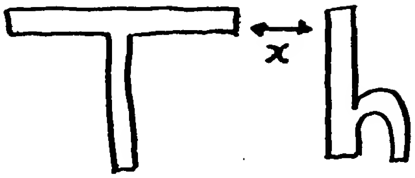

FIG. 1

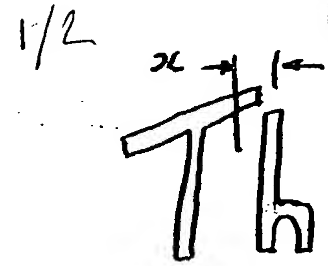

FIG. 2

FIG. 3

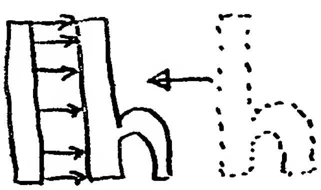

FIG 4

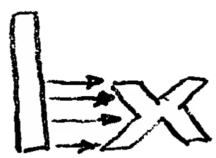

FIG 5

FIG 6

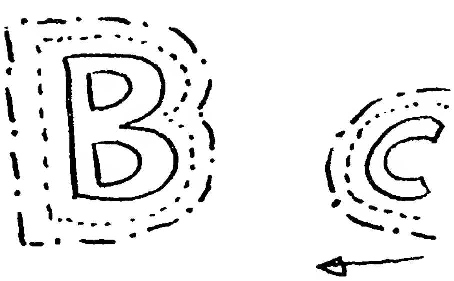

FIG 7

FIG. 8

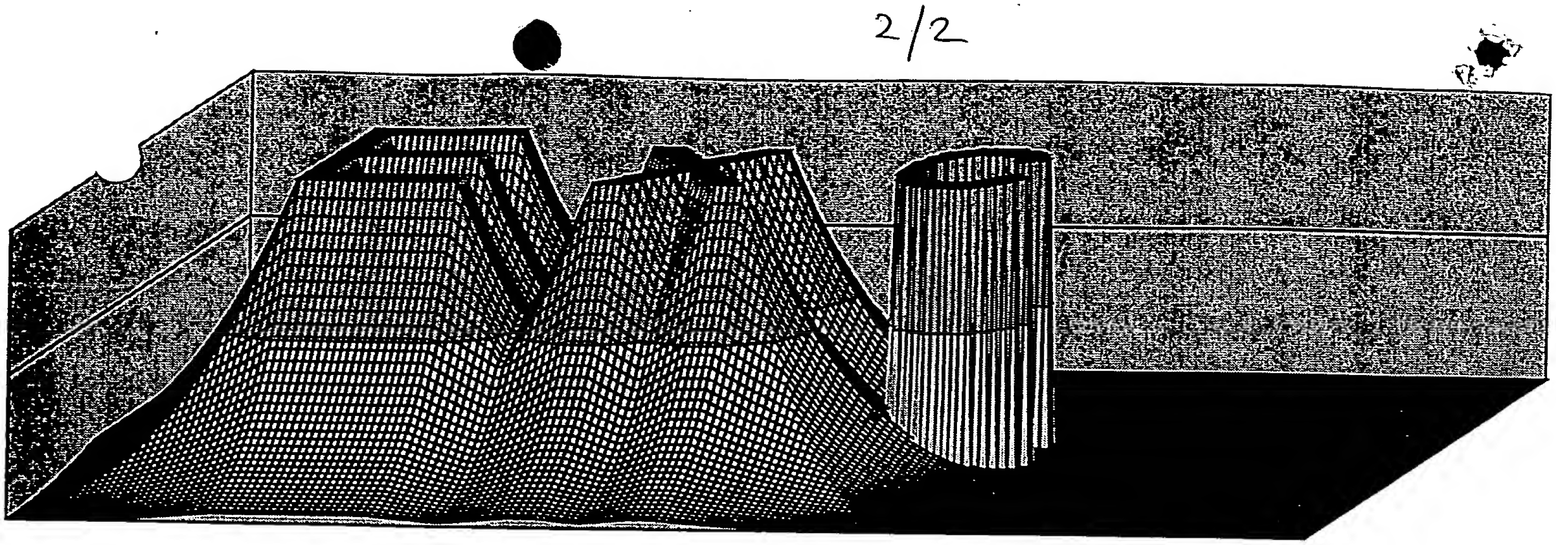

Fig 9

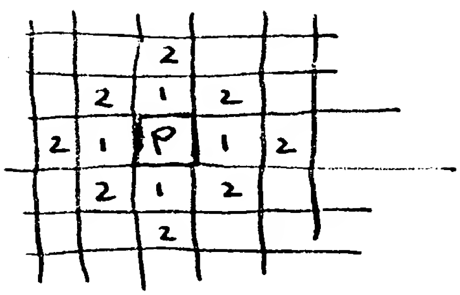

Fig 10

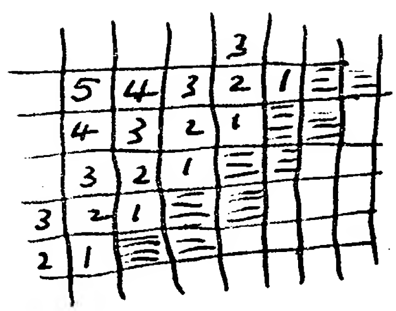

Fig. 11

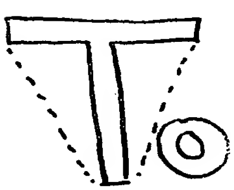

Fig 12

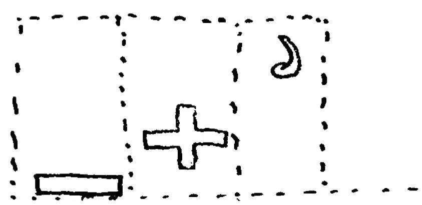

Fig 13

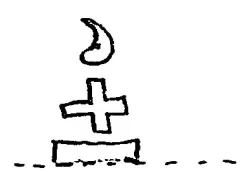

Fig 14